Scenario Data Sources

Brian Kiger
Seagull Technology
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Overview

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- Context
- Motivation
- Data Discussions
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  - Key Scenario Parameters
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Data Significance Prelude

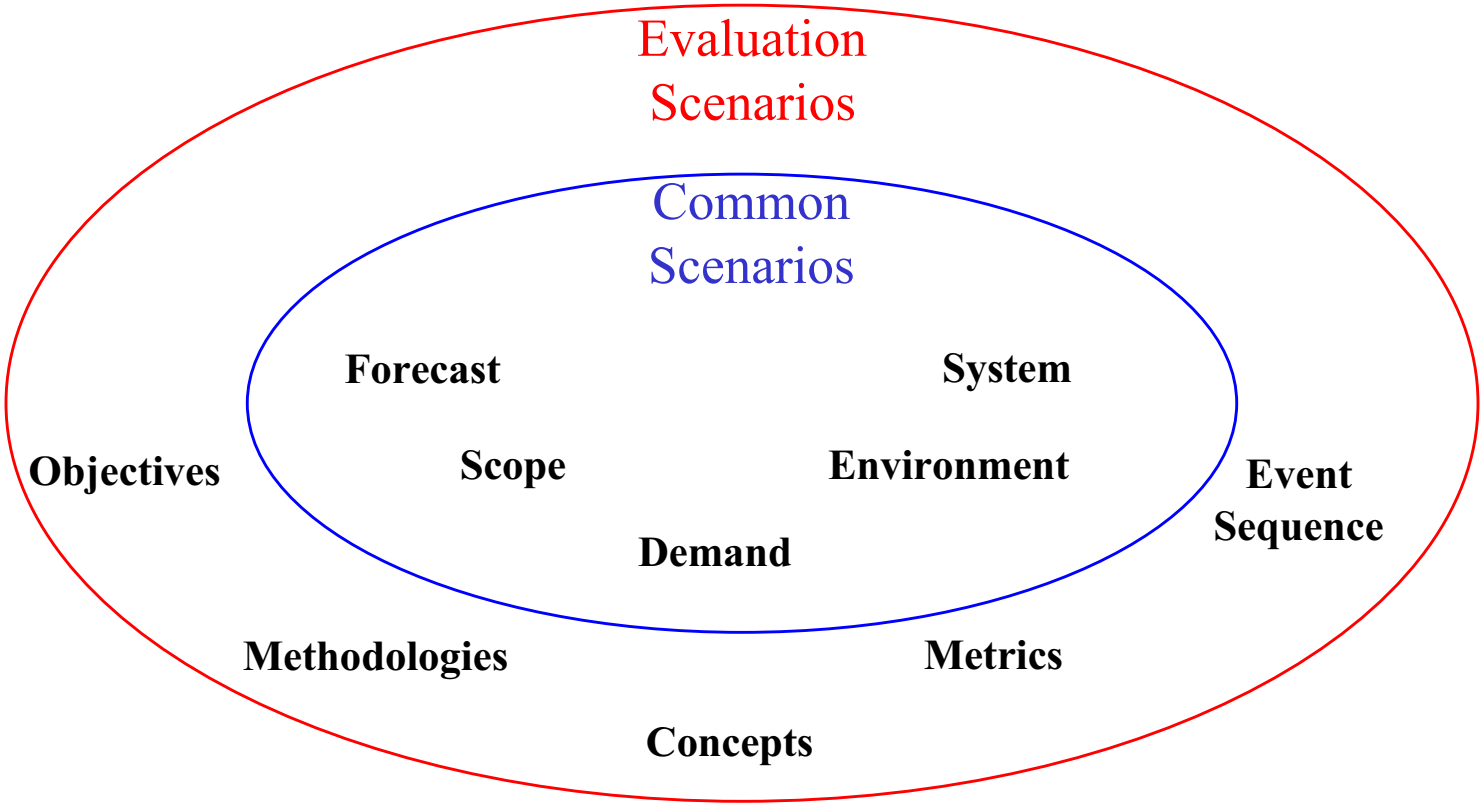
- Ensure realism with high fidelity data
- Test validity of concept
- Creates a basis for standardization
- Repository of data affords the developer more attention on the concept
- Ability to quickly modify data creates more thorough analysis

Context

- An important concern for usability of identified potential scenario parameters was the availability of existing data sources. The Seagull SEA Team searched for information about available data sources for all important scenario parameters
- A key data source index was generated to locate data sources

D. Schleicher, A. Huang, G. Couluris, S. Lockwood, B. Kiger, D. Signor, R. Kelley, “Proposed SEA Scenario Requirements”, Seagull Technology, Nov. 2002.

Context: Scenario Building Blocks



Common Scenarios:

Concept-independent data to support all desired VAMS concept evaluations

Evaluation Scenarios:

All data needed to support a specific VAMS concept evaluation

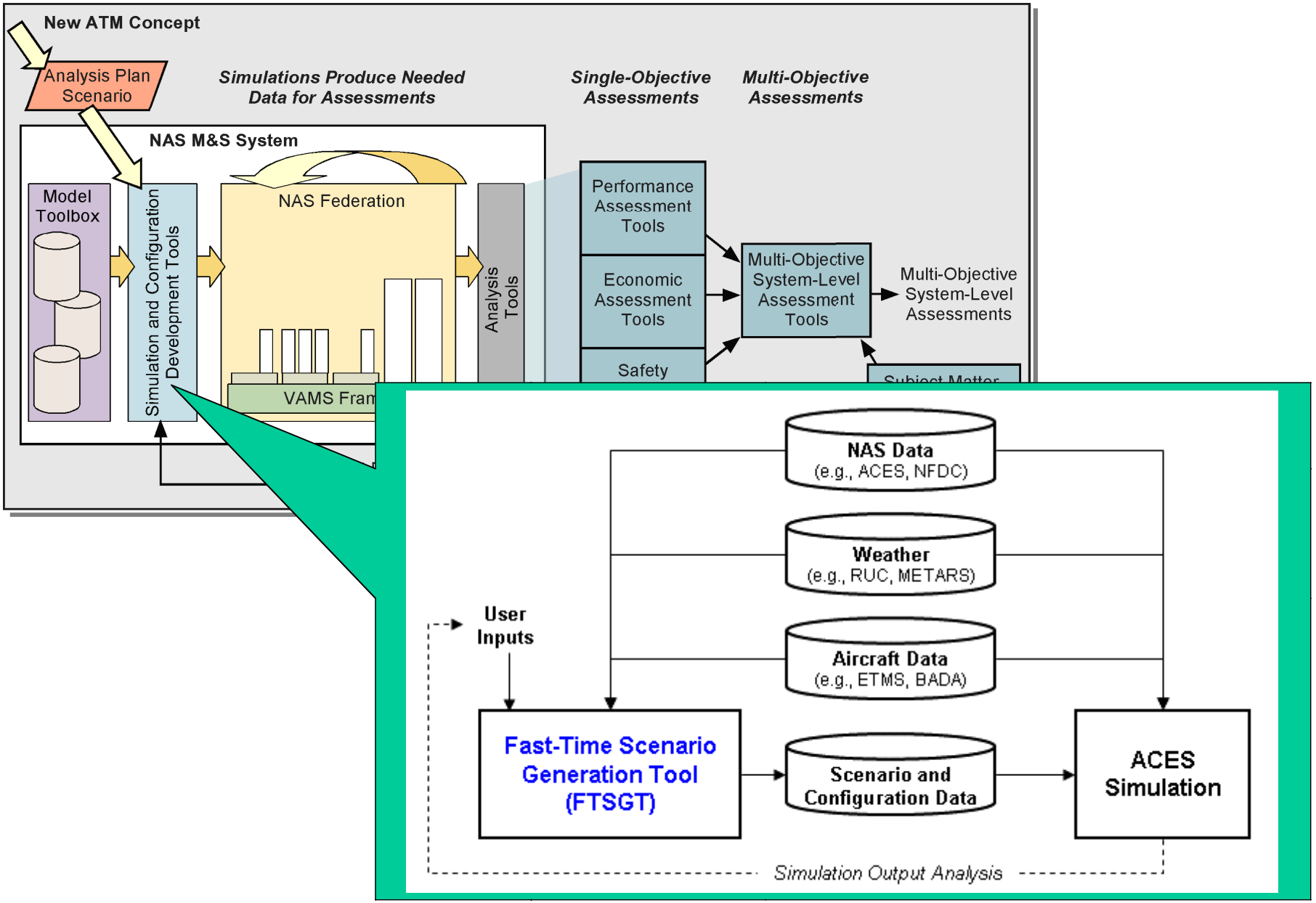
Context: Common Scenarios

- **Forecast**
  Delineates the state of the NAS in which the SLIC concept will be tested, including "NAS today" and projections of a future NAS.
- **Demand**
  Provides a definition of the passenger and cargo transportation demand and the aircraft and flight characteristics desired by the airspace users satisfying the transportation demand.
- **Scope**
  Provides a definition of the range of the physical, temporal, and operational dimensions of the Common Scenario.
- **System**
  Provides a definition of the characteristics of the National Airspace System into which one would insert aspects of a new air traffic management operational concept. Detailed information from the System category can be used as the basis from which to measure the benefits of any given operational concept and can provide a common baseline to be used for generating apples-to-apples benefits comparisons.
- **Environment**
  Provides a definition of the weather, safety, and security aspects to a Common Scenario that would cause significant disturbances to the nominal air traffic flow.

Context: Evaluation Scenario

• OBJECTIVES	• CONCEPTS	• METHODOLOGIES	• EVENT SEQUENCE	• METRICS
• questions	• flight management	• analysis	• pilot actions	• capacity/ throughput
• assumptions	• air traffic management	• fast-time simulation	• ATC actions	• efficiency
	• fleet management	• real-time simulation	• TFM actions	• taskload
	• communicati on		• AOC actions	• safety
	• navigation		• disturbances	• environment
	• Traffic surveillance		• demand/ capacity imbalances	• acceptability
	• weather surveillance			• cost

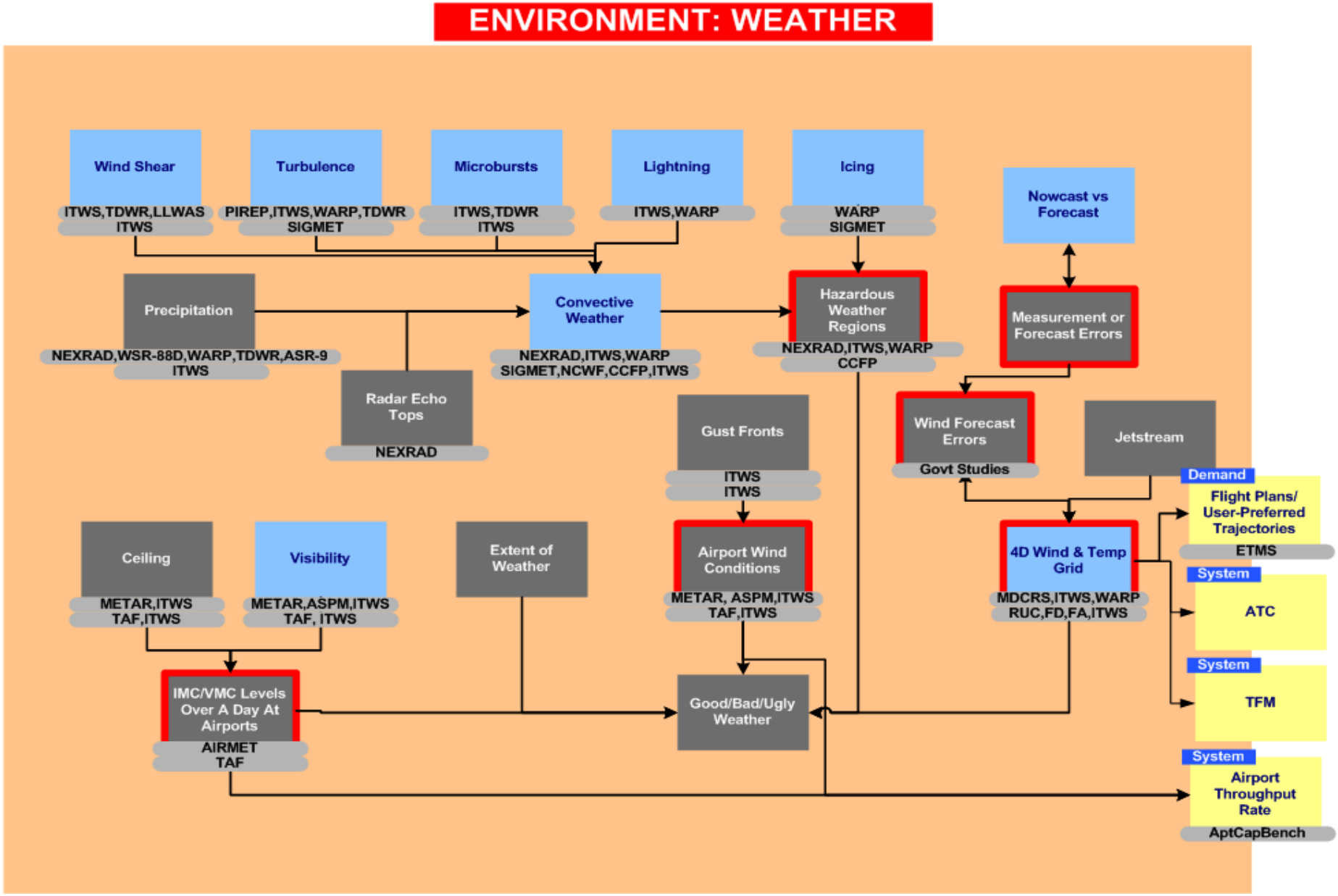
Motivation


New ATM Concept
Analysis Plan Scenario
Simulations Produce Needed Data for Assessments
Single-Objective Assessments
Multi-Objective Assessments
NAS M&S System
Model Toolbox
Simulation and Configuration Development Tools
NAS Federation
Analysis Tools
Performance Assessment Tools
Economic Assessment Tools
Safety
Multi-Objective System-Level Assessment Tools
Multi-Objective System-Level Assessments
NAS Data
(e.g., ACES, NFDC)
Weather
(e.g., RUC, METARS)
Aircraft Data
(e.g., ETMS, BADA)
User Inputs
Fast-Time Scenario Generation Tool (FTSGT)
Scenario and Configuration Data
ACES Simulation
Simulation Output Analysis

Motivation: Testers of the Concepts

- Under what conditions does the concept fail?
  - Do we have the right data to excite all modes of our concept?
- Where does the concept excel in benefits?
  - What data sets are required to demonstrate concept benefits?
- What are the boundaries of the concept?
  - What data is required to determine costs, physical & operational?
- What modifications to the concept are needed to fix a “bug”?
  - What data is needed to create the problem? Is the data at the same fidelity as the concept?
- How do we know that one concept is scrutinized equally to another concept?
  - Is the data standardized across the concepts?
- How quickly can we iterate?
  - Can the data be quickly manipulated to form new tests?

Determination of High Priority Parameters



High-Priority Scenario Parameter List

- **Forecast:**
  - Time Period, Direct Operating Costs, Airline Yields, GDP Growth, Substitutes to Commercial Air Travel, Limits to Aviation System Growth
- **Demand:**
  - Flight Plans, User Preferred Trajectories, Flight Schedules, RPM, Load Factor, Passenger/Cargo Forecast for each OD pair, Fleet Mix, Airline Network Configuration
- **System:**
  - **Aircraft:** Aircraft Model/Type, Aircraft Performance, Fuel Burn, Emissions, Noise Profile, Equipage Rates, Number of Available Seats, Weight, Wake Turbulence Category, SRS Category
  - **Airport:** Noise Abatement Procedures, Gates, Cat I/II/III Instrument Approaches, Runway Characteristics, Runway Configuration, Taxiways, Ramps, Airport Location, Airport ID
  - **Airspace:** Airspace Boundaries, Fixes, Airways/Routes, Sector Capacity
  - **Flight Management:** Fix Crossing Performance, Runway Occupancy Time Performance, Weather Avoidance Strategy, Inter-Aircraft Separation Performance
  - **ATM: Air Traffic Control:** Airspace and Staff Management, ATC Procedures (w/ separation standards), ATC Separation Buffer Size, Operating Procedures Retention and Application, Airspace Routing and Traffic Structuring, Airspace CD&R Application, Runway Traffic Management, Ground Traffic Management, Route Clearance Issue
  - **ATM: Traffic Flow Management:** TFM Procedures with Separation Standards, NAS wide Airport Planning (GDP/GSP), NAS-wide Reroute Planning, Flight Plan Approval, Regional Flow Planning (MIT, TBM, Reroutes), Terminal Area Flow Planning (MIT, TBM), Airport Operating Planning (AAR)
  - **Communication:** Message Transmission Frequency of Occurrence, Ground Equipage – Communication, Actual Communication Performance, Required Communication Performance, Fleet Equipage – Communication
  - **Navigation**: Fleet Equipage Rate – Navigation, RNP, Required Vertical Navigation Performance
  - **Surveillance**: Required Surveillance Performance, Trajectory Intent Errors, Ground Equipage – Surveillance, Actual Surveillance Performance, Fleet Equipage – Airborne Surveillance
  - **Fleet Management**: Flight Delay Policy, Flight Cancellation Policy
- **Environment:**
  - **Weather:** Hazardous Weather Regions, Measurement or Forecast Errors, Wind Forecast Errors, Apt Wind Conditions, 4D Wind and Temp Grid, IMC/VMC Levels
  - **Safety and Security:** Security Situations, Safety Situations, Failures
- **Scope:**
  - Physical Scope, Temporal Scope, Operational Scope, Model Fidelity

Data Mining

- Primary Sources
  - Critical Recordings: SAR, CDR
  - Airspace design: NFDC
  - Weather: RUC, WARP, ITWS
- Secondary Sources
  - TMA
- Modify data from existing sources
  - Flight Plan modification
  - Airport Loading or AOC schedules
  - Modify accuracy of surveillance or navigation
- Generate data from scratch
  - Model communications via data link instead of voice
  - Model new airports or configurations
  - Model new aircraft performance characteristics

Primary Data Sources

- **Forecast:**
  - APO Economics, Form 41, DOC Bureau of Economic Analysis
- **Demand:**
  - ETMS, T-100, APO Forecasts, Passenger O&D Survey, OAG
- **System:**
  - **Aircraft**: 7110.65, Manufacturer Data, BADA, Performance Manuals, Boeing/ICAO Indices, INM, T-100, Airline Ops
  - **Airport:** Airport Facility Directory, NFDC, Airport Plan, EPS, NOAA Charts, TAF, ACES, ACB01, AC 150/5060-5
  - **Airspace**: NFDC, ACES, NOS, ETMS, NOTAM-D
  - **Flight Management**: SAR, CDR, ASDE, Government Studies, Airline Operations manuals, ETMS
  - **ATM: Air Traffic Control**: 7110.65, SAR, CDR, Studies
  - **ATM: Traffic Flow Management**: TFM Logs, ATCSCC Logs, 7110.65
  - **Communication**: Government Studies, Industry Studies, NAS Architecture
  - **Navigation**: Industry Studies, Avionics Specs, FAA AC
  - **Surveillance**: EDX Data, Government and Industry Studies
  - **Fleet Management**: none
- **Environment: Weather:**
  - NEXRAD, ITWS, WARP, CCFP, Government Studies, METAR, ASPM, ITWS, TAF, MDCRS, RUC, FD, FA, AIRMET
- **Environment:**
  Safety and Security:
  - none
- **Scope:**
  ETMS, ACES, NOS, NFDC

Secondary Data Sources

CM_SIM File

ADD_FLIGHT_PLAN 231 N737DX/PHX.0918 ZFW N737DX 0918 -NS- 2656 T/B734/F PHX./.DR..BKW.JASEN2.IAD/1515 HOB288032 1148 330 430 ESTIMATED_FP

#Newly received flight plan info

#ADD_FLIGHT_PLAN elapsed_time enhanced_ACID data_source_config_id callsign cid(center id) tid(tracon id) beacon code ac_type route coordination_fix faa_coord_time assigned_altitude file_speed flight_plan_status

#where flight_plan_status: PROPOSED_FP(still on the ground), ESTIMATED_FP(in air out of Center airspace), DEPARTED_FP(taken off)

TMC_INPUT 55935 PROC_TGUI 23 BROADCAST_ALL

#TMC input messages to the cm_sim file
#TMC_INPUT elapsed_time input_source (PROC_TGUI, PROC_CM, etc.) 23 message
#where message:
#
AIRCRAFT_FIND_SLOT ACID
AIRPORT_FLOW_CHANGE airport_name acceptance_rate start_time
DELETE_AIRPORT_FLOW airport_name time
FREEZE_HORIZON_SETTINGS fhs_string
TWO_WAY_METERING flag(1:ON 0:OFF)
PRIORITY_AIRCRAFT ACID user_constraint_modes PRIORITY_MODE(1:ON 0:OFF)

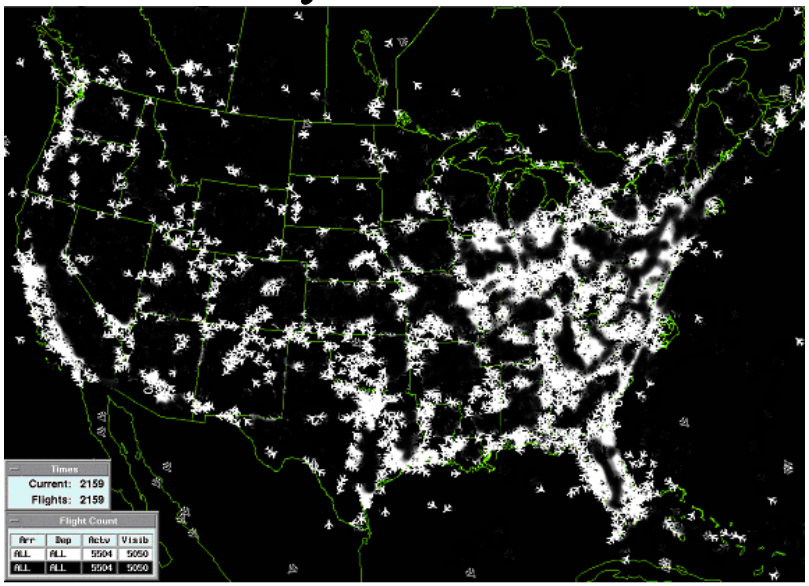
AC_DATA 56 CAA844/ILE.0318 427.12259 138.05383 313537N 0975427W 14100 236 29.07816 0 54.24 62 F N N ZFW

#tracked data for an aircraft
#AC_DATA elapsed_time enhanced_ACID x y latitude longitude altitude ground_speed heading vertical_speed time sector_id coast(T/F) turn_status altitude_status data_source_ config_id

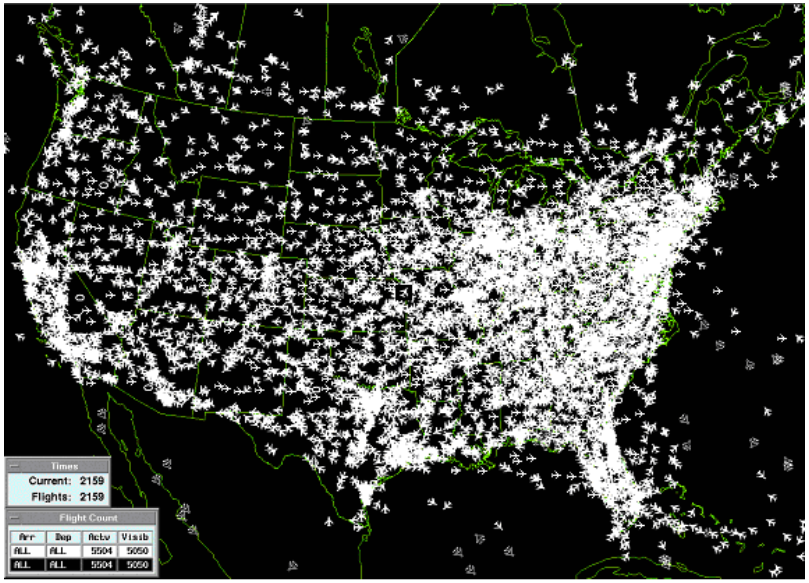
Modification of Data

- Flight Plans
- Track Information
- Communications
- Navigation Capabilities
- Airport Loading
- Aircraft Characteristics
- ATC Tools
- Wx Conditions
- Safety Procedures
- Passenger Demand
- Economics
- Recovery Time

Today's Traffic

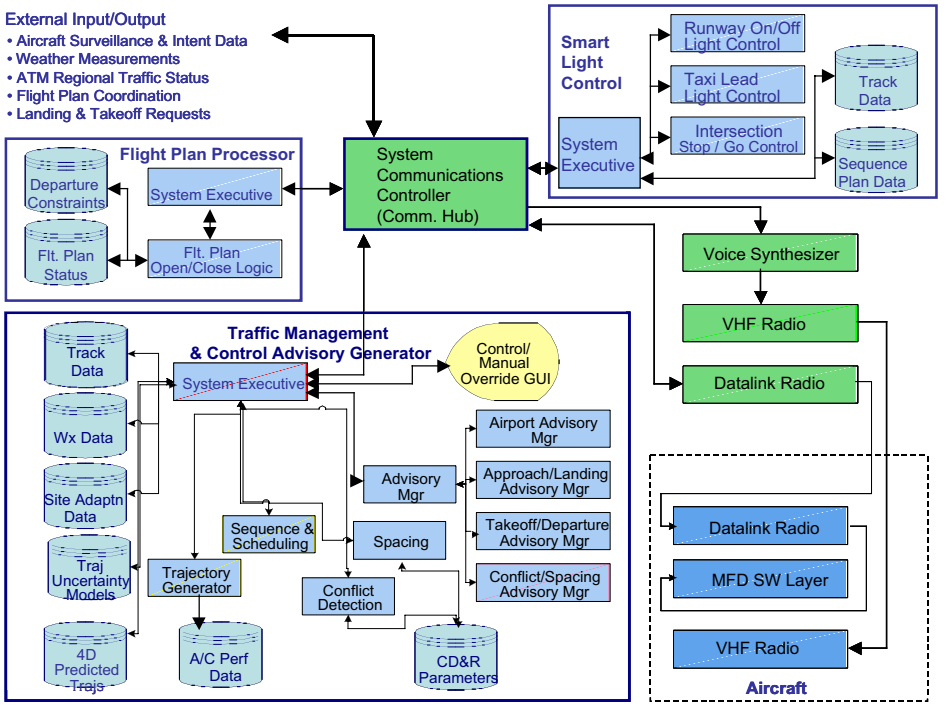


2020 Traffic



Generate Data from Scratch

- Communication Latency
- Self Separation
- Airspace Changes
- Procedural Changes
- New Aircraft Types
- Modified Equipment Capabilities
- New Airports or Runways



Data Significance

- Ensure realism with high fidelity data
  - Routes, Airspace Boundaries, Tracks, Wx
- Test validity of concept
  - The concept is measured against realistic, high integrity data
- Creates a basis for standardization
  - Utilization of the same data for common scenarios
- Repository of data affords the developer more attention on the concept
  - With a defined process, each developer will not have to search for the data
- Ability to quickly modify data creates more thorough analysis
  - Need the tools to move the data to 2020 timeframe

Suggested Data Capturing Actions

- Determine what data is required for the common and evaluation scenarios
- Determine the level of fidelity required
- Determine which data source provides required information
- Create a process for capturing data sources
- Ensure that common data sources are accessible to all SLIC developers
- Determine how data will be manipulated to generate the appropriate tools
- Determine which data will be generated from scratch